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NATIONAL UNIVERSITY OF IRELAND GALWAY

SUMMER EXAMINATIONS 2010

Bachelor of Science in Information Technology

ARTIFICIAL INTELLIGENCE (CT421) - 4IF1

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Time allowed: *three* hours.

Attempt *two* questions from section A AND *two* questions from section B.

1. (a) Given the following database:

   $distance(galway, oranmore, 5).$
   $distance(oranmore, loughrea, 17).$
   $distance(loughrea, ballinasloe, 18).$
   $distance(galway, oughterard, 17).$
   $distance(galway, claregalway, 6).$
   $distance(claregalway, tuam, 14).$

   where $distance(X, Y, Z)$ is defined as the distance between place X and place Y is Z miles.

   (i) Write a rule $find\_distance(X, Y, Z)$ which returns the distance between two adjacent towns. Your rule should work for both directions.
   For example the query:
   $find\_distance(galway, oranmore, Dist).$
   would give the result:
   $Dist = 5$
   and the query:
   $find\_distance(loughrea, oranmore, Dist).$
   would give the result:
   $Dist = 17$

   - What results would your rule return in answer to the query:
     $find\_distance(X, Y, 17).$

   (5 marks)

   (ii) Write a rule $long\_distance(X, Y, Z)$ which checks that the distance between towns X and Y is Z. Your rule should allow for longer journeys, for example the query:
   $long\_distance(tuam, galway, Dist).$
   would give the result:
   $Dist = 20$

   - What results would your rule return in answer to the following queries:
     $long\_distance(ballinasloe, tuam, X).$
     $long\_distance(Galway, loughrea, X).$
     $long\_distance(X, Y, Z).$
     (7 marks)

   (b) Describe the mechanism Prolog uses to attempt to satisfy queries. Illustrate your answer with an example.

   (4 marks)

   (c) Describe the Closed World Assumption, in particular discuss its effect on Prolog.

   (4 marks)

2. (a) Write a Prolog predicate, sum(X,Y), that takes two arguements. The first of these
arguements is a list of integers. Return the sum of these integers as the second arguement.

(8 marks)

(b) What will your code do for the following calls:

(i) sum([1,2,3,4],X).

(ii) sum([1,3,5,7],12).

(iii) sum([[1,2,3,4]],X).

(iv) sum(X,[1,2,3,4]).

(4 marks)

(c) Write a Prolog predicate that reverses the list contained in the first arguement, and
returns it as the second arguement.

(8 marks)

3. (a) Explain what is meant by Qualitative Reasoning. What are its advantages and disadvantages.

   (3 marks)

   (b) Give an example of an application where Qualitative Reasoning would be suitable. Justify your answer.

   (2 marks)

   (c) Give an example of an application where Qualitative Reasoning would not be suitable. Justify your answer.

   (2 marks)

   (d) Given the following constraints (which represent the motion of a ball being thrown in the air):

$$DERIV(x, v)$$
$$DERIV(v, a)$$
$$a = g < 0$$

   and the quantity spaces:

$$\{-\infty, 0, \infty\} \; for \; v$$
$$\{0, top\} \; for \; x$$

   If the initial state is:

$$QS(x, t_1) = < top, std >$$
$$QS(v, t_1) = < 0, dec >$$
$$QS(a, t_1) = < g, std >$$

   What are the possible next states?

Rule-id	$QS(v, t_i)$	$QS(v, t_i, t_{i+1})$
P1	$< l_i, std >$	$< l_i, std >$
P2	$< l_i, std >$	$< (l_i, l_{i+1}), inc >$
P3	$< l_i, std >$	$< (l_{i-1}, l_i), dec >$
P4	$< l_i, inc >$	$< (l_i, l_{i+1}), inc >$
P5	$< (l_i, l_{i+1}), inc >$	$< (l_i, l_{i+1}), inc >$
P6	$< l_i, dec >$	$< (l_{i-1}, l_i), dec >$
P7	$< (l_i, l_{i+1}), dec >$	$< (l_i, l_{i+1}), dec >$

   (10 marks)

   (e) What discrete states would the ball pass through after being thrown up into the air?

   (3 marks)

SECTION B

4. (a) You have been tasked with developing a search algorithm for an adventure game. It has been suggested that Dijkstras algorithm or A* should be used. The game makes extensive use of healthpacks and teleportation. Which algorithm would you prefer and why?

(7 marks)

(b) A zone equivalency array is often used to indicate what may be traversed in game levels. Consider a game that has the following three types of terrain: land, water, impassible. Illustrate how such arrays work by considering zone arrays for (1) a land and (2) an amphibious vehicle.

(7 marks)

(c) What is meant by the term hierarchical path finding and why might it be used in a game?

(6 marks)

5. (a) What is meant by the term finite state machine?

(6 marks)

(b) Explain the difference between immediate and deferred transitions

(6 marks)

(c) You are tasked with implementing retaliation behaviour in a finite state machine. Would this be easier to implement in an active state transition or child states compete control model in your view?

(8 marks)

6. (a) In the context of genetic algorithms, what is meant be the term fitness function?

(6 marks)

(b) Explain the difference between roulette wheel selection and tournament selection

(6 marks)

(c) You are tasked with developing an offline genetic algorithm to find the shortest path through a maze. Sketch the principal elements that would inform your development.

(8 marks)